Separation and Sealing of a Sample Container Using Brazing

This process is an alternative to a prior explosive welding process.

NASA's Jet Propulsion Laboratory, Pasadena, California

A special double-wall container and a process for utilizing the container are being developed to enable (1) acquisition of a sample of material in a "dirty" environment that may include a biological and/or chemical hazard; (2) sealing a lid onto the inner part of the container to hermetically enclose the sample; (3) separating the resulting hermetic container from the dirty environment; and (4) bringing that hermetic container, without any biological or chemical contamination of its outer surface, into a clean environment. The process is denoted "S^{3}B" (separation, seaming, and sealing using brazing) because sealing of the sample into the hermetic container, separating the container from the dirty environment, and bringing the container with a clean outer surface into the clean environment are all accomplished simultaneously with a brazing operation. This container and process were conceived as a superior alternative to the double-wall container and process described in "Explosion Welding for Hermetic Containerization" (NPO-20868), *NASA Tech Briefs*, Vol. 27, No. 8 (August 2003), page 46. As in the previously reported case, the present container and process were originally intended to be used to return samples from Mars to Earth, but could also be used on Earth to store and transport material samples acquired in environments that contain biological and/or chemical hazards.

Figure 1 depicts the configuration, prior to the S^{3}B process, of the double-wall container and an interface assembly that includes a structure that holds the lid and serves as a barrier between the clean and dirty environments. The upper end of the container is sized and shaped to mate with the lid. For the S^{3}B process, the outer wall of the double-wall container includes, near its upper end, integral portions in the form of three rings of a brazing material that melts at a temperature well below the melting temperature of the rest of the container. There is also a similar ring of brazing material on the upper surface of a

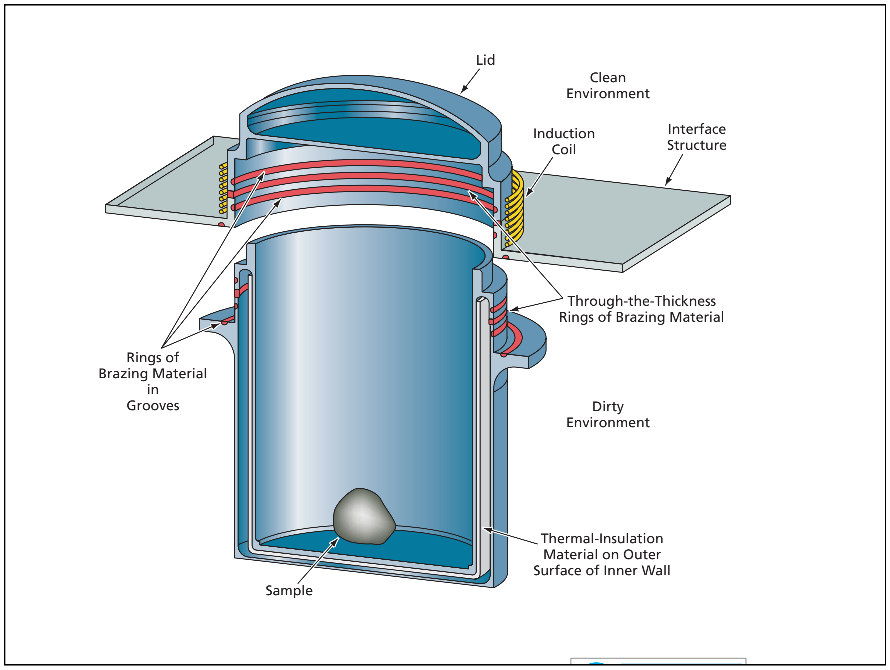

Figure 1. **Before the S^{3}B Process**, the double-wall container and the sample inside it are in the dirty environment.

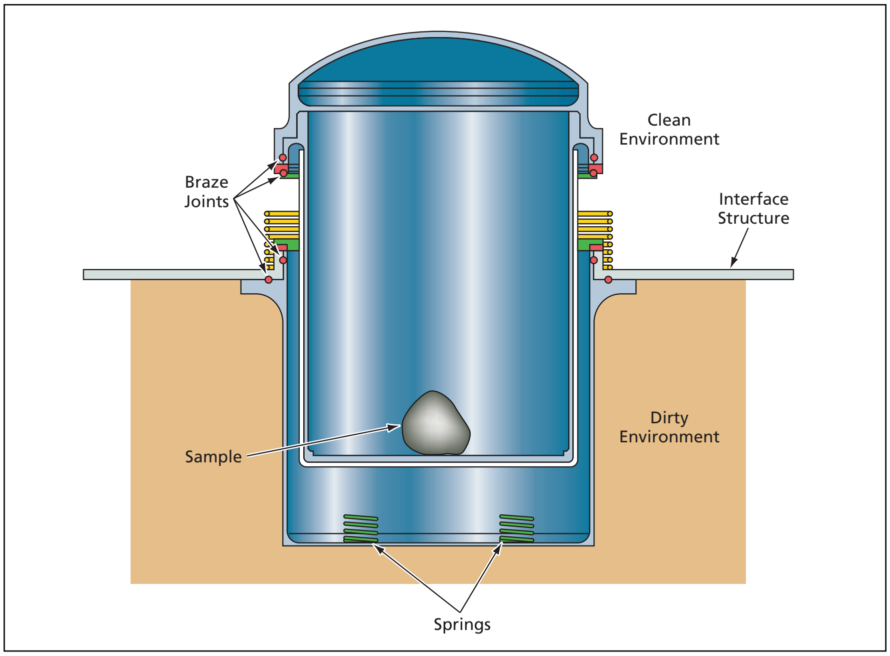

Figure 2. **After the S^{3}B Process,** the sample is hermetically sealed into a container newly created from the inner wall of the double-wall container and the lid, and the newly created container resides in the clean environment.

flange that is part of, and near the upper end of, the outer wall. Inside the lid and on the structure that holds the lid are similar rings of brazing material positioned to mate with those on the double-wall container. The middle ring of brazing material on the cylindrical portion of the outer wall occupies the full thickness of the wall; similarly, the mating middle ring of brazing material in the cylindrical portion of the lid occupies the full thickness of that part of the lid. On the clean side, an induction-heating coil surrounds the lid. At the bottom end of the double-wall container, between the inner and outer walls, are springs poised to push the inner portion of the container lengthwise out of the outer portion.

Immediately before starting the S^3B process, a mechanism pushes the double-wall container into mating with the lid. The S^3B process is started by applying power to the induction-heating coil to melt the rings of brazing material, thereby causing the following events to occur simultaneously:

- The outer wall of the double-wall container becomes brazed to the interface structure, thereby ensuring maintenance of the separation between the clean and dirty environments.
- The inner wall of the double-wall container becomes brazed to the lid, thereby creating an inner container and hermetically sealing the sample into it.
- Once the through-the-thickness rings of brazing material melt, there is nothing left to hold the inner container to the outer container or to hold the lid to the interface structure. Consequently, the springs push the newly created hermetic container away from the outer container/interface structure, into the clean environment (see Figure 2).

The brazing material is chosen to have a sufficiently high melting temperature (typically >500 °C) so that the brazing process sterilizes the outer surface of the lid/wall seam region of the newly created hermetic container. The outer surface of the inner container is covered with a layer of thermal-insulation material to prevent heat damage of the sample during brazing. Alternatively, in an application in which there is no concern about biological contamination, it could be feasible to substitute a lower-melting-temperature solder for the brazing material.

This work was done by Yoseph Bar-Cohen, Tommaso P. Rivellini, James E. Wincentsen, and Robert Gershman of Caltech for NASA's Jet Propulsion Laboratory. Further information is contained in a TSP (see page 1).
NPO-41024